minimum. The worked-out exercises show that the mode of working is easy of apprehension and leads to correct results. A merit of the book, for frequent use, is that it is handy in form and very clearly printed.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

The so-called "Bunsen-Pump"

PROF. ROSCOE, *President* of the Chemical Society of London, in enumerating the works of his friend Prof. Bunsen, says, in NATURE of the 28th ult. ("Scientific Worthies," vol. xxiii. p. 600):—

"To him we are also indebted for the apparatus for accelerating filtration, the 'Bunsen-pump,' together with all its appliances, now employed in every laboratory."

This assertion requires correction. The pump used by Prof. Bunsen for accelerating filtration was invented by me, and not by Prof. Bunsen, as would appear from the use of his name in connection with it. I described the construction of the "WATER-air-pump" distinctly and plainly in the *Journal* of the Chemical Society of London for January, 1865, under the title, "Researches on the Vacuum: I. The Instruments" (not the instrument, as some will read), and I sent a copy of this paper to Prof. Bunsen, inscribed with a suitable allusion to our former relationship as pupil and teacher, during the spring of 1865. Three years later Prof. Bunsen published his paper, "On the Washing of Precipitates," in which he described again my pump, *but unfortunately omitted to quote my paper of* 1865.

The following is a translation of Prof. Bunsen's own words:—

"To create the difference of pressure for filtration one cannot employ any of the air-pumps commonly used, especially not the mercury-air-pump, as the liquids to be filtered contain not unfrequently chlorine, sulphurous acid, sulphuretted hydrogen, and other substances, which would destroy the metallic portions of the apparatus. I therefore employ a water-air-pump constructed of glass on the principle of Sprengel's mercury-air-pump, which for all chemical purposes is, as I believe, preferable to every other apparatus for air rarefaction, where it suffices to push the rarefaction no further than to a pressure of mercury from 6 to 12 millimetres" (*Ann. Chem. Pharm.*, 1868, vol. cxlviii. p. 277).

The peculiar stress laid here on the uselessness of mercury-air-pumps, and on the fact that chlorine attacks mercury, combined with the omission of all reference to my paper, where both *water and glass* are mentioned, gave to Prof. Bunsen's description of the instrument a colour of originality which Prof. Roscoe (and with him many others) thinks right to support and to perpetuate by calling it the "Bunsen-pump."

As this misnomer has been already the subject of a disclaimer from Prof. Bunsen (NATURE, vol. vii. p. 241), of remonstrances both from myself (vol. vii. p. 241), from Prof. Frankland (vol. xiv. p. 74), and from others, I am sorry to see that Prof. Roscoe should continue to use this designation, which is intended to honour an "*employer*" of the instrument, which hurts the feelings of its inventor and deprives him of his only reward—the satisfaction of being credited with having placed a useful servant at the disposal of science and industry.

If any other inventor less eminent than Prof. Bunsen had made the omission which I have pointed out with much reluctance, no one would persist in giving his name to my child, nor (reversing the case) would anybody speak of a pump as "Sprengel's pump," if I had received from Prof. Bunsen the paper of 1865 and said in 1868, "I therefore employ a water-air-pump constructed of glass on the principle of Bunsen's mercury-air-pump."

H. SPRENGEL

Savile Club, London, May 7

[I have read the foregoing note of expostulation from Dr. Sprengel, and I regret that I have hurt his susceptibilities. That Dr. Sprengel first enunciated the principle both of the water- and of the mercury-air-pump no one can doubt. But that Bunsen devised a water-pump suitable for filtration there can be as little doubt. Hence in speaking of a "filter-pump"—as every chemist knew I was doing—as contradistinguished from an "air-pump," I conceive that I am justified in using the words "Bunsen-pump."—H. E. ROSCOE.]

Tide-Predicting Machines

THE recent discussions respecting tide-predicting machines have called to mind a very old invention of my own, which, although originally designed for a different purpose, seems to me capable of solving the required problems with all attainable accuracy.

I communicated to the British Association at Cambridge in 1845 "A description of a Machine for finding the Numerical roots of Equations and Tracing a variety of useful Curves." An abstract of that paper may be found at pages 3, 4, of the *Transactions* of the sections. About the same time I lithographed for private distribution a more detailed account of the proposed machine, illustrated by diagrams. It begins with the remark that "Persons engaged in testing theory by experiment have frequently derived great assistance from mechanical contrivances, which give rapid and near approximations without the trouble, in every separate case, of going through tedious multiplications and additions. The proposed machine would be capable of giving values of $\Sigma\{b \cos (n\theta + \alpha)\}$, or of tracing the curve $\rho = \Sigma\{b \cos (n\theta + \alpha)\}$."

At page 2 it is shown how it was proposed to trace the curve $\rho = a + b \cos (n\theta + \alpha)$. It is then remarked that, in the same way, it would be possible to trace the curve $\rho = a + b \cos (n\theta + \alpha) + b_1 \cos (n_1\theta + \alpha_1) + b_2 \cos (n_2\theta + \alpha_2)$, &c. Then follow a variety of suggestions for the practical use of the instrument, and at page 7 there are the following suggestions for the construction of a machine:—

"As toothed wheels cannot be employed to turn the circles (A_1), (A_2), &c., I have made use of a combination of the endless screw and toothed wheels so that the error of the wheels is almost destroyed. H (Fig.) represents a handle attached to an axis on which are mounted toothed wheels $t_1\ t_2\ t_3$ . . . which gear with the wheels $T_1\ T_2$, &c., mounted on separate axes, each having a portion of a very accurate screw. These act on the circumferences of the circles (A_1) (A_2), &c., and cause them to revolve uniformly, as in Ramsden's dividing engine, &c." The large diagram shows four of these (A) circles, each of which gives one term, $b \cos (n\theta + \alpha)$, and these terms are summed by the help of a chain, such as is used to wind up watches, passing over pulleys carried by frames free to oscillate in parallel directions. I inclose copies of the lithographed description of the instrument.

May 9 F. BASHFORTH

Sound of the Aurora

IN NATURE, vol. xxiii. p. 484, one of your correspondents speaks of the sound of the aurora as "crackling," or as that of "the flickering of blazing fire," while another describes it as like the "rustling or switching of silk." On Monday, April 12 last, there was an electric storm here, and at 7 p.m. when I walked home (the blazing lightning leaving but *momentary intervals* of darkness), I heard all round me the constant crackling or rustling of blazing flames. Towards the north-west across a low arc near the horizon pale sheet lightning swayed quickly to and fro. There was no rain at the time, that came heavily afterwards. The sound of flames was close round me, and others had the same experience. No one I can find has ever seen lightning so completely fill the air or heard such strange sounds.

F. C. CONSTABLE

Karachi, April 25

Meteorological Bibliography

I AM compiling a classified bibliography of meteorological science, and being desirous of rendering it as full as possible, I should feel much obliged if you would intimate to meteorologists that by sending copies of their papers to me they would do much towards helping on the work. The publication of this bibliography has already commenced in "The Scientific Roll."

6, Kent Gardens, Ealing, W. A. RAMSAY

An Optical Illusion

THERE is an exquisite optical phenomenon of which I (and doubtless many others too) would be glad to see a really scientific

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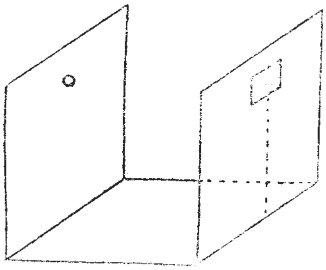
and physiological explanation. Cannot some one of your numerous scientific contributors favour us with one?

It is this: Take a slip of thin card about three inches long and one wide. Bend up the two end inches at right angles. Perforate one of these vertical ends with a pin-hole, and the other directly and concentrically opposite with a square hole



Observe.—The pin may be placed horizontally, or in any position, with the same result.

about one-eighth of an inch square. Place a small pin in this end, so that the head may be nearly in the middle of the square hole. Now apply this end to your eye and look through both holes at the sky, and you will see the pin apparently beyond the round hole and reversed in position! WILLIAM WILSON

Eirene, Chester, May 4

[This very pretty experiment seems novel. The explanation is, of course, excessively simple. What is seen is the *shadow* of the pin, thrown on the retina by the light diverging from the small hole. As the shadow is erect on the retina, it produces vision of an inverted pin. This appears to be situated about the distance of most distinct vision (ten inches or so), and therefore behind the hole.—ED.]

LAURENCE HARGRAVE, Sydney, should refer to the letter of the Rev. R. Abbay on the "Rayons de Crépuscule" in vol. xviii. p. 329, and the articles and correspondence therein referred to.

SCIENCE IN CHINA[1]

II.

IT is a generally received opinion that the Chinese language presents extraordinary difficulties, both in its acquisition by Europeans and in its use for the expression of the more exalted ideas of Western learning. The attempt to translate modern scientific or technical books into a language so ancient, so crude, and so unchanging is regarded by many who have not given careful attention to the matter as almost absurd. It is readily granted by them that such subjects as the doctrines of Christianity or affairs of a political nature might be expressed easily in the language of a people among whom religion and diplomacy have for ages been carried to a considerable state of advancement. But from the almost total absence of native scientific literature and pursuits there is necessarily a paucity of scientific terms, and this appears at first sight to form an almost impassable barrier to the use of Chinese for scientific purposes. A little investigation however will show that this opinion is without foundation; and that from the time the early Jesuit missionaries commenced their compilations up to the present day no serious difficulties have been experienced by foreign translators.

The question of nomenclature, however, is one that naturally has to be met at the outset. If it were necessary to use only such terms as are to be found in standard Chinese dictionaries, or if it were forbidden to give any new shades of meaning to existing characters the task of translation could never be accomplished. But it must be borne in mind that the Chinese, like other languages, is capable of growth. The increasing intercourse of China with Western nations is undoubtedly making vast additions to the number of words in current use. The Emperor, it is true, has the power of deciding the exact manner in which characters are to be written, and in various instances certain characters have been forbidden to be written in certain ways; but he is powerless to check the changes and additions that are now fast taking place in the language all over the Empire. Where it has become necessary to express a new idea, or to give a name to a new object in Chinese, there has always been found a way of managing the matter more or less satisfactorily; and hence some very clumsy specimens of nomenclature are gradually becoming current, especially among such natives as have much intercourse with foreigners. Of course all such new terms have to stand or fall on their own merits, and if radically wrong or misleading they are pretty certain eventually to be supplanted by better ones. This is merely what naturally happens in the growth of all languages, and although many inconveniences necessarily occur when terms have to be changed, yet there seems to be no help for it. It will be remembered that when the English language began to borrow largely from Greek and Latin, many scientific and technical terms were coined which have since fallen into disuse or been supplanted by others. So it must necessarily be in Chinese with regard to the words borrowed from the English or other languages.

It ought, however, to be possible for the pioneers of modern sciences and arts in China, by exercising great care and by working in harmony, to establish such a system of nomenclature that no very extensive alterations need be made in future years. A Chinaman of ordinary intelligence ought to be able to take up the translation of a work on such a subject as chemistry, for instance, and understand the nomenclature quite as well as a European of similar capacity, and, knowing nothing of chemistry, would understand the original when placed in his hands for the first time. Every new term being explained or defined only when first used, it would of course be useless for an ordinary Chinaman to begin in the middle of such a work and expect to understand everything he read. And yet not only Chinese but foreigners have been known to treat the translations published at the Arsenal in this way. Finding the nomenclature unintelligible to themselves or their Chinese friends, or their teachers or writers, they have condemned all such attempts to express the higher branches of Western learning in Chinese as useless, and have come to the conclusion that the study of European languages is the only way in which satisfactory progress will ever be made in China.

Before commencing the work of the Translation Department it was seen to be necessary to establish a system by which the nomenclature to be employed should be determined. After considerable discussion the following plan was agreed upon by those who organised the department:—

1. *Existing Nomenclature.*—Where it is probable a term exists in Chinese, though not to be found in dictionaries—

a. To search in the principal native works on the arts and sciences, as well as those by the Jesuit missionaries and recent Protestant missionaries;

b. To inquire of such Chinese merchants, manufacturers, mechanics, &c., &c., as would be likely to have the term in current use.

2. *Coining of New Terms.*—Where it becomes necessary to invent a new term, there is a choice of three methods:—

a. Make a new character, the sound of which can easily be known from the phonetic portion, or use an existing but uncommon character giving it a new meaning.

b. Invent a descriptive term, using as few characters as possible.

c. Phoneticise the foreign term, using the sounds of the

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[1] By Mr. John Fryer, Chief Translator to the Chinese Arsenal. Continued from p. 11.

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